

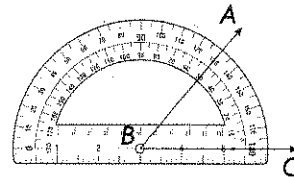
Name \_\_\_\_\_

## Identify and Draw Angles

**Essential Question** How do you identify and draw different types of angles?

**CONNECT** We can label the parts of angles and classify them by their measures.

**G.8.5.2** Identify and draw *congruent, adjacent, obtuse, acute, right* and *straight* angles (Label parts of an angle: *vertex, rays, interior* and *exterior*)



### UNLOCK the Problem REAL WORLD

A **ray** is part of a line that has one endpoint and extends endlessly in one direction. Two rays with the same endpoint form an **angle**. The shared endpoint is called a **vertex**. The **interior** of the angle lies between the two rays that make up the angle. The **exterior** of the angle lies outside the two rays that make up the angle.

#### Math Idea

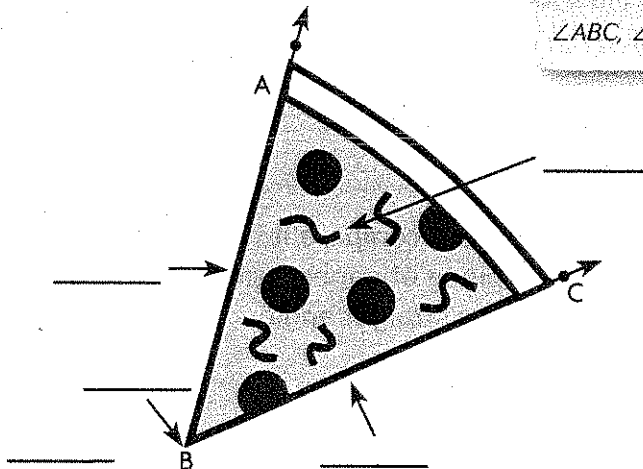
Rays are named with two capital letters. The first is the endpoint, and the second is any other point on the ray.

The vertex is named with one capital letter.



**Label the parts of the angle.**

Angles can be found anywhere two lines meet. Even the point of a slice of pizza forms an angle. Label the two rays, the vertex, and the exterior of the angle below.



#### Remember

You can name an angle in different ways:

$\angle ABC$ ,  $\angle CBA$ ,  $\angle B$

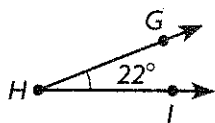
Ray \_\_\_\_\_ and ray \_\_\_\_\_ intersect at vertex \_\_\_\_\_ to form \_\_\_\_\_.

1. The space taken up by the slice of pizza represents the \_\_\_\_\_.

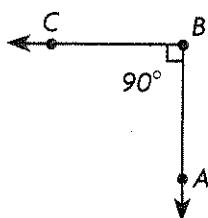
2. The space outside the pizza represents the \_\_\_\_\_.

## Types of angles.

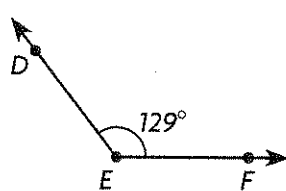
An angle can be classified according to the size of the interior.



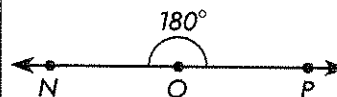
An **acute** angle measures greater than  $0^\circ$  and less than  $90^\circ$ .



A **right** angle measures  $90^\circ$ . A  $\square$  is used to indicate an angle is right.



An **obtuse** angle measures greater than  $90^\circ$  and less than  $180^\circ$ .



A **straight** angle measures  $180^\circ$ . A straight angle forms a line.



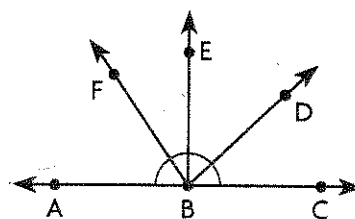
**Example** Measure each of the angles below with a protractor. Then classify each as acute, right, obtuse, or straight.

$\angle FBC$  is \_\_\_\_\_ because its measure is \_\_\_\_\_.

$\angle EBC$  is \_\_\_\_\_ because its measure is \_\_\_\_\_.

$\angle DBC$  is \_\_\_\_\_ because its measure is \_\_\_\_\_.

$\angle ABC$  is \_\_\_\_\_ because its measure is \_\_\_\_\_.

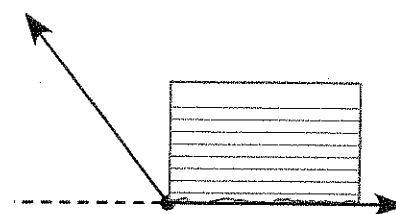


## Try This!

To estimate the size of an angle, you can compare it to a benchmark angle. The corners of a piece of paper form right angles. Any straight edge forms a straight angle.

Use a benchmark to draw an obtuse angle.

- Use a straight edge to draw a ray.
- Continue the ray in the opposite direction with a dotted line.
- Line one of the corners of a piece of paper with the ray.
- Use a straightedge to draw another ray between the dotted line and the edge of the paper.



### Math Talk

How do you know the angle you drew was obtuse?

Name \_\_\_\_\_

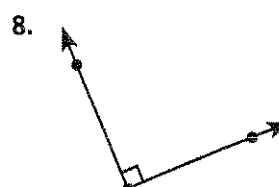
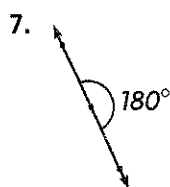
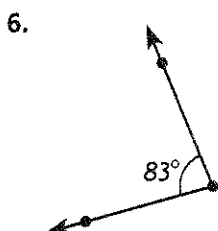
## Share and Show



Draw and label an example of each angle. Identify and name the vertex and rays of each angle.

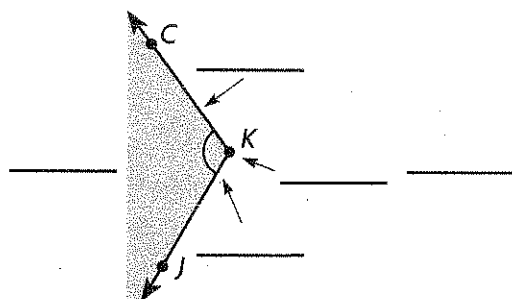
1. right angle  $ABC$       2. obtuse angle  $DEF$       3. straight angle  $JKL$       4. acute angle  $MNO$

Classify each angle as acute, right, obtuse, or straight.



## On Your Own

Use the diagram below to complete 9 and 10.

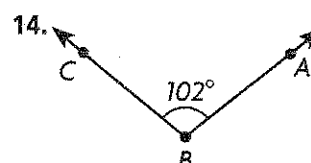
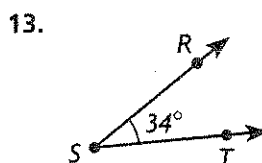
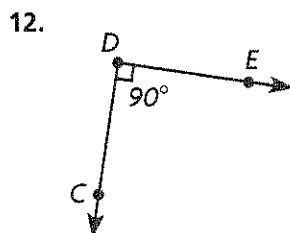
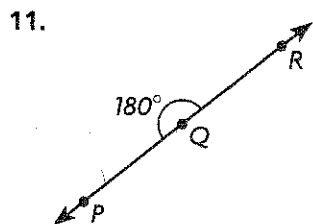


### Math Talk

Explain how you know the names of the rays that form an angle.

9. Label the two rays, the vertex, the interior, and the exterior of the angle.
10. Ray \_\_\_\_\_ and ray \_\_\_\_\_ intersect at vertex \_\_\_\_\_ to form \_\_\_\_\_.

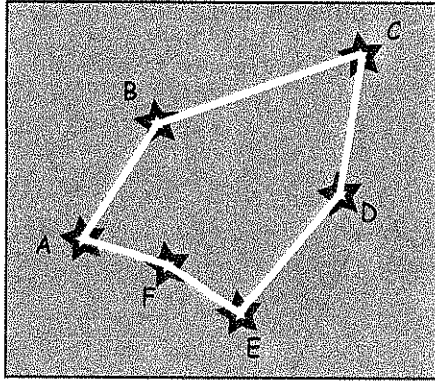
Classify each angle as acute, right, obtuse, or straight.



## Problem Solving

REAL WORLD

Astronomers study the stars and other objects in space. Cepheus is a constellation of stars named after an ancient mythological Greek king. Cepheus is visible in the northern sky all year. The diagram below is a model of the constellation. Trace it and then answer 15 and 16.



15. Which angles appear to be acute? obtuse?

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16. Use a protractor to measure each of the angles to verify that your answers to 15 are correct.

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17. **Write Math** Explain how to use a protractor to draw acute angle  $MNQ$ .

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18. **HOT** An engineer is developing a new subdivision in your town. Why is it best for him to design streets that intersect at right angles?

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19. **★ Test Prep** Which best describes an angle that has a measure of  $145^\circ$ ?

(A) acute      (B) obtuse      (C) right      (D) straight

Name \_\_\_\_\_

## Angle Relationships

**Essential Question** How do you identify and describe angle relationships?

Angles sometimes have special relationships with each other.

**Vertical angles** are formed opposite each other when two lines intersect. Vertical angles have the same measure. Angles that have the same measure are **congruent**. The symbol  $\cong$  is used to indicate congruence. Use the letter  $m$  to indicate the measure of an angle. Read  $m\angle B$  as "the measure of angle B."

**G.8.5.2** Identify and draw *congruent, adjacent, obtuse, acute, right* and *straight* angles (Label parts of an angle: *vertex, rays, interior* and *exterior*)

### UNLOCK the Problem REAL WORLD

Westchester County Airport has 2 runways that intersect to form the 4 angles shown.



**Identify vertical angles.**

The intersecting runways are modeled by 2 lines that intersect to form 4 angles.

$\angle$  \_\_\_\_\_ and  $\angle$  \_\_\_\_\_ are opposite each other, so they are \_\_\_\_\_ angles.  $\angle$  \_\_\_\_\_ and  $\angle$  \_\_\_\_\_ are opposite each other, so they are \_\_\_\_\_ angles. Since vertical angles are congruent,  $\angle$  \_\_\_\_\_  $\cong$   $\angle$  \_\_\_\_\_ and  $\angle$  \_\_\_\_\_  $\cong$   $\angle$  \_\_\_\_\_.

The intersecting runways also form adjacent angles. **Adjacent angles** are side by side and have a common vertex and a common ray.

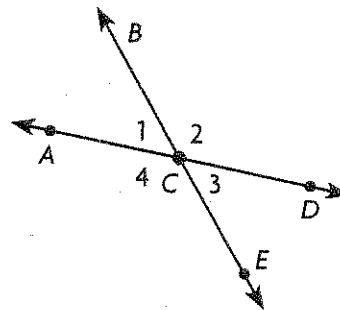
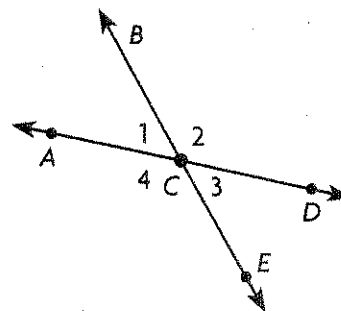


**Identify a pair of adjacent angles.**

Look for angles that share a vertex and that have a ray that is common to both of them.

$\angle$  \_\_\_\_\_ and  $\angle$  \_\_\_\_\_ are side by side and share ray CB.

So,  $\angle$  \_\_\_\_\_ and  $\angle$  \_\_\_\_\_ are \_\_\_\_\_ angles.



1. If  $m\angle 2 = 140^\circ$ , what is  $m\angle 4$ ? \_\_\_\_\_

2. Name three other pairs of adjacent angles.

$\angle$  \_\_\_\_\_,  $\angle$  \_\_\_\_\_;  $\angle$  \_\_\_\_\_,  $\angle$  \_\_\_\_\_;  $\angle$  \_\_\_\_\_,  $\angle$  \_\_\_\_\_

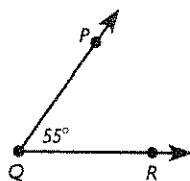
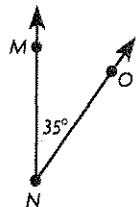
#### Math Talk

What definition did you use to find  $m\angle 4$ ?

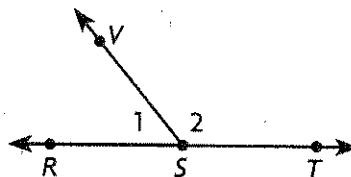
When the sum of the measures of two angles is  $90^\circ$ , the angles are called **complementary angles**. When the sum of the measures of two angles is  $180^\circ$ , the angles are called **supplementary angles**.



Identify complementary and supplementary angles.



Complementary and supplementary angles can be adjacent or nonadjacent (not adjacent).



$$35^\circ + 55^\circ = \underline{\hspace{2cm}}, \text{ so } \angle MNO$$

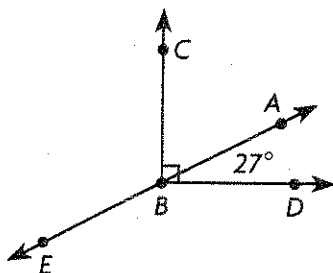
and  $\angle PQR$  are  $\underline{\hspace{2cm}}$ .

$$m\angle 1 + m\angle 2 = m\angle RST = \underline{\hspace{2cm}},$$

so they are  $\underline{\hspace{2cm}}$ .



Identify each pair of angles as complementary angles or supplementary angles. Then find their measures.



**Hint:** Write the angle measures into the diagram as you find them.

$\angle CBA$  and  $\angle CBE$  make a straight angle.

$\angle DBA$  and  $\angle EBD$  form straight angle  $\underline{\hspace{2cm}}$ .

$$m\angle DBA + m\angle EBD = m\angle ABE = \underline{\hspace{2cm}}, \text{ so they are } \underline{\hspace{2cm}}.$$

$$m\angle DBA \text{ is } 27^\circ. \text{ So, } m\angle EBD = 180^\circ - m\angle DBA = 180^\circ - \underline{\hspace{2cm}} = \underline{\hspace{2cm}}.$$

$\angle DBA$  and  $\angle ABC$  form right angle  $\underline{\hspace{2cm}}$ .

$$m\angle DBA + m\angle ABC = m\angle DBC = \underline{\hspace{2cm}}, \text{ so they are } \underline{\hspace{2cm}}.$$

$$m\angle DBA \text{ is } 27^\circ. \text{ So, } m\angle ABC = 90^\circ - m\angle DBA = 90^\circ - \underline{\hspace{2cm}} = \underline{\hspace{2cm}}.$$

3. What other term can be used to describe  $\angle DBA$  and  $\angle ABC$ ?  $\underline{\hspace{2cm}}$ .

**Math Talk**

Are  $\angle EBD$  and  $\angle ABC$  vertical?

Name \_\_\_\_\_

# Share and Show



For 1–7, use the figure at right.

Identify an example of the types of angles named.

1. adjacent angles

\_\_\_\_\_

3. supplementary angles

\_\_\_\_\_

5. If  $m\angle 6 = 42^\circ$ , what is  $m\angle 4$ ?

\_\_\_\_\_

2. vertical angles

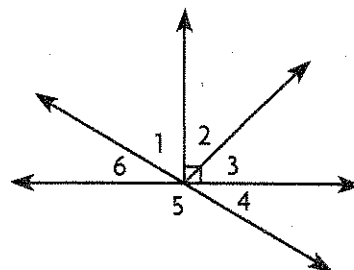
\_\_\_\_\_

4. complementary angles

\_\_\_\_\_

6. If  $m\angle 3 = 51^\circ$ , what is  $m\angle 2$ ?

\_\_\_\_\_



7. **Write Math** Explain why you cannot tell whether  $\angle 3$  and  $\angle 4$  are complementary.

**Math Talk** Can a pair of angles be both vertical and adjacent?

Draw a pair of angles with the listed characteristics:

8. nonadjacent and congruent

9. adjacent and complementary

# On Your Own

For 10–16, use the figure at right. Name a pair of:

10. adjacent angles

\_\_\_\_\_

12. supplementary angles

\_\_\_\_\_

14. If  $m\angle 3 = 63^\circ$ , what is  $m\angle 1$ ?

\_\_\_\_\_

11. vertical angles

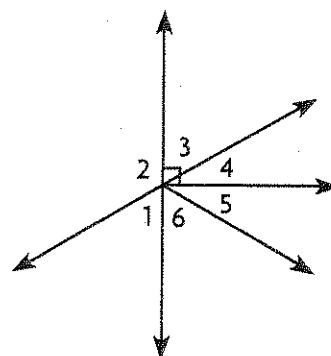
\_\_\_\_\_

13. complementary angles

\_\_\_\_\_

15. If  $m\angle 3 = 63^\circ$ , what is  $m\angle 2$ ?

\_\_\_\_\_



16. **Write Math** Explain why you cannot tell whether  $\angle 3$  and  $\angle 4$  are congruent.

\_\_\_\_\_

Draw a pair of angles with the listed characteristics:

17. adjacent and congruent

18. nonadjacent and supplementary

# Problem Solving



Use the information below to answer 19–21.

The 2 main runways of the airport in Champaign, Illinois, intersect. Angle 1, created by the intersection, has a measure of  $136^\circ$ .

19. What are the measures of the 4 angles formed by the runways?

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20. Explain how you found  $m\angle 2$ .

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21. Explain how you found  $m\angle 3$  and  $m\angle 4$ .

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22. **HOT** Draw a pair of angles that are adjacent, congruent, and complementary. Explain how to find the measures of the angles.

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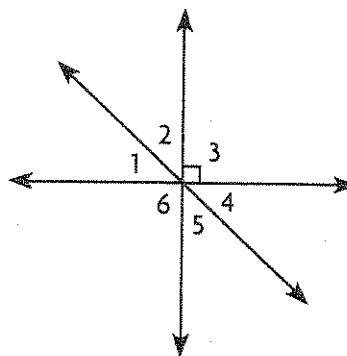
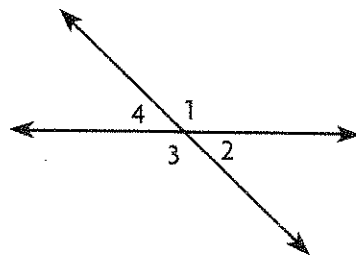
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23. **★ Test Prep** Which angle is adjacent to  $\angle 1$ ?

- (A)  $\angle 3$
- (B)  $\angle 4$
- (C)  $\angle 5$
- (D)  $\angle 6$





Name \_\_\_\_\_

## Circles

**Essential Question** How can you identify the parts of a circle?

A **circle** is a closed figure made up of points that are the same distance from a point called the **center** of the circle. Circles are named by the center point.

**G.8.5.3** Model and identify circle, *radius*, *diameter*, *center*, *circumference* and *chord*

### UNLOCK the Problem

#### Parts of a circle.

**A** A line segment with one endpoint at the center of the circle and the other endpoint on the circle is called a **radius**.

So,  $\overline{EA}$ ,  $\overline{ED}$ ,  $\overline{EB}$  and are each a radius of circle  $E$ .

**B** A line segment that passes through the center of the circle and has both of its endpoints on the circle is called a **diameter**.

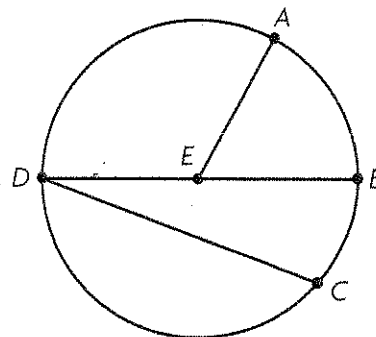
So,  $\overline{DB}$  is a diameter of circle  $E$ .

**C** A line segment that has its endpoints on the circle is a **chord**.

So,  $\overline{DC}$  and  $\overline{DB}$  are chords of circle  $E$ .

**D** The **arc** of a circle is a curved section of the circle between two points.

So,  $\widehat{AB}$ ,  $\widehat{AD}$ ,  $\widehat{DC}$ , and  $\widehat{CB}$  are arcs of circle  $E$ .



Circle  $E$

#### Remember

A chord is any line segment that begins and ends on the circle. So, the diameter of a circle is also a chord.

#### Try This!

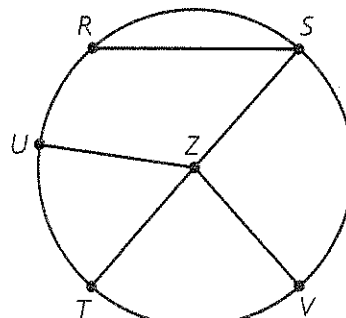
Write the names for the parts of a circle. Use circle  $Z$ .

**A**  $\overline{RS}$  is a \_\_\_\_\_.

**B**  $\overline{ZT}$  is a \_\_\_\_\_.

**C**  $\widehat{UT}$  is an \_\_\_\_\_.

**D**  $\overline{TS}$  is a \_\_\_\_\_.



Circle  $Z$



**Example** Use circle  $F$ . Name the parts of the circle.

**Name a diameter.**

A diameter is a line segment that passes through the \_\_\_\_\_  
of the circle and has both of its \_\_\_\_\_ on the circle.

So, a diameter of circle  $F$  is \_\_\_\_\_.

**Name a chord.**

A chord is a \_\_\_\_\_ that has its endpoints on the circle.

The points that are on circle  $F$  are \_\_\_\_\_.

So, a chord of circle  $F$  is \_\_\_\_\_.

**Name a radius.**

A radius is a line segment with one endpoint at the \_\_\_\_\_  
of the circle and the other endpoint on the circle.

The center of circle  $F$  is point \_\_\_\_\_.

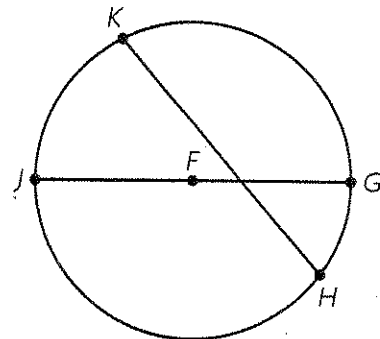
An endpoint on the circle which connects to the center is point \_\_\_\_\_.

So, a radius of circle  $F$  is \_\_\_\_\_.

**Name an arc.**

An arc of a circle is a \_\_\_\_\_ of the circle between two endpoints.

So, an arc of circle  $F$  is \_\_\_\_\_.



**Circle  $F$**

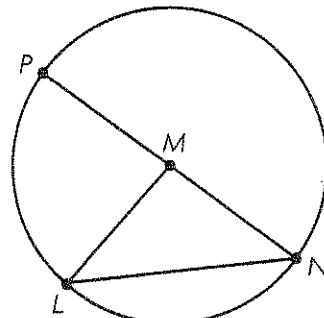
**Try This!** Use circle  $M$ . Identify the parts of the circle.

Name an arc. \_\_\_\_\_

Name a diameter. \_\_\_\_\_

Name a radius. \_\_\_\_\_

Name a chord. \_\_\_\_\_



**Circle  $M$**

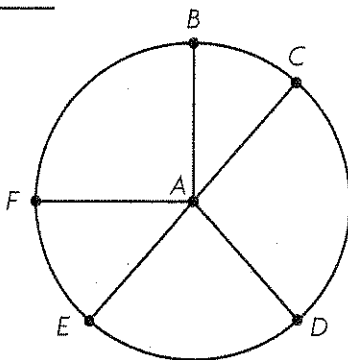
Name \_\_\_\_\_

# Share and Show



1. Name a chord for circle A. \_\_\_\_\_

Think: A chord is any line segment that has its endpoints on the circle.



## Math Talk

Can the radius of a circle also be a chord? Explain.

For 2–5, use circle Q. Identify parts of the circle.

2. Name a diameter.

\_\_\_\_\_

3. Name an arc.

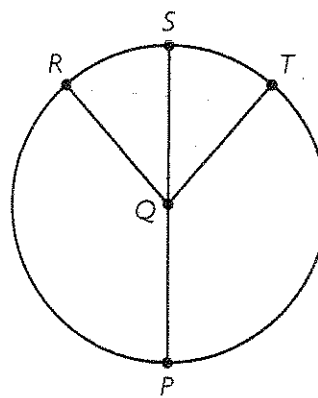
\_\_\_\_\_

4. Name a chord.

\_\_\_\_\_

5. Name a radius.

\_\_\_\_\_



# On Your Own

For 6–9, use circle D. Identify parts of the circle.

6. Name an arc.

\_\_\_\_\_

7. Name a chord.

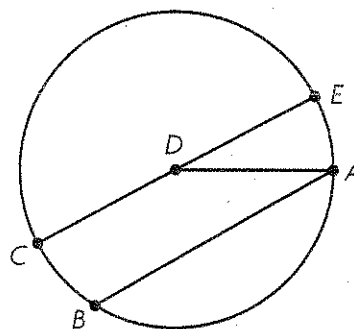
\_\_\_\_\_

8. Name a radius.

\_\_\_\_\_

9. Name a diameter.

\_\_\_\_\_



For 10–13, use circle Y.

Write the names for the parts of the circle.

10.  $\overline{XV}$

\_\_\_\_\_

11.  $\widehat{VZ}$

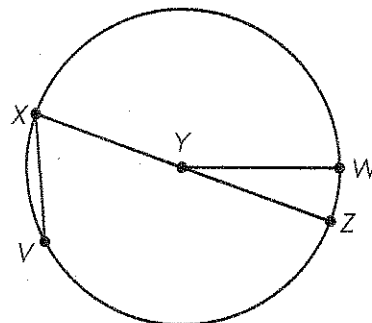
\_\_\_\_\_

12.  $\widehat{YZ}$

\_\_\_\_\_

13.  $\overline{XZ}$

\_\_\_\_\_

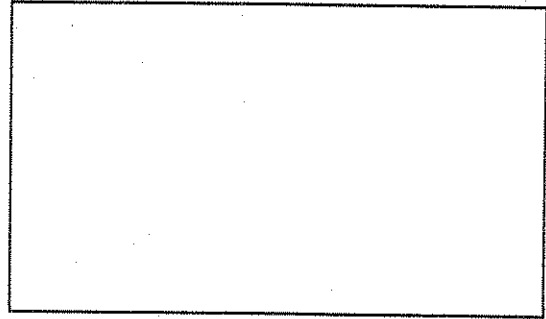


# Problem Solving

REAL WORLD

14. Draw a circle with the following characteristics:

- Center at P
- $\overline{PG}$  is a radius
- $\overline{MC}$  is a diameter
- $\overline{MG}$  is a chord



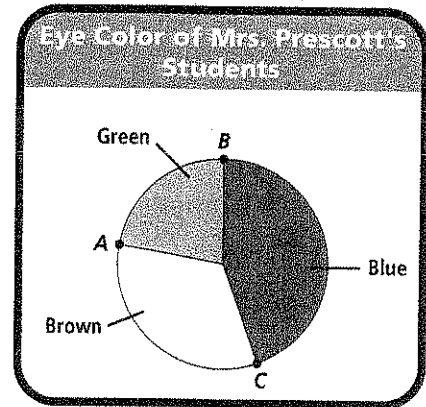
15. **CONNECT** Circle graphs are often used to display categories of data. This circle graph displays the eye color of the students in Mrs. Prescott's class.

- Name the arcs in the graph from smallest to largest. \_\_\_\_\_
- How do you know that blue eyes are the most common in Mrs. Prescott's class?

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16. **NOTE** What's the error? Asha drew a circle with center point M. She labeled  $\overline{AB}$  as a radius. How do you know she is incorrect?

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17. **Write Math** Determine if the statement is true or false. Explain below why each of the false statements are not true.

- Every diameter is a chord. \_\_\_\_\_
- Every chord is a diameter. \_\_\_\_\_

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18. **★ Test Prep** Which arc cannot be found in circle C?

- |                    |                    |
|--------------------|--------------------|
| (A) $\widehat{AB}$ | (C) $\widehat{DA}$ |
| (B) $\widehat{BC}$ | (D) $\widehat{EB}$ |

